1st week of the pregnancy

Fertilization

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Clinical anatomy

1st week of the pregnancy:

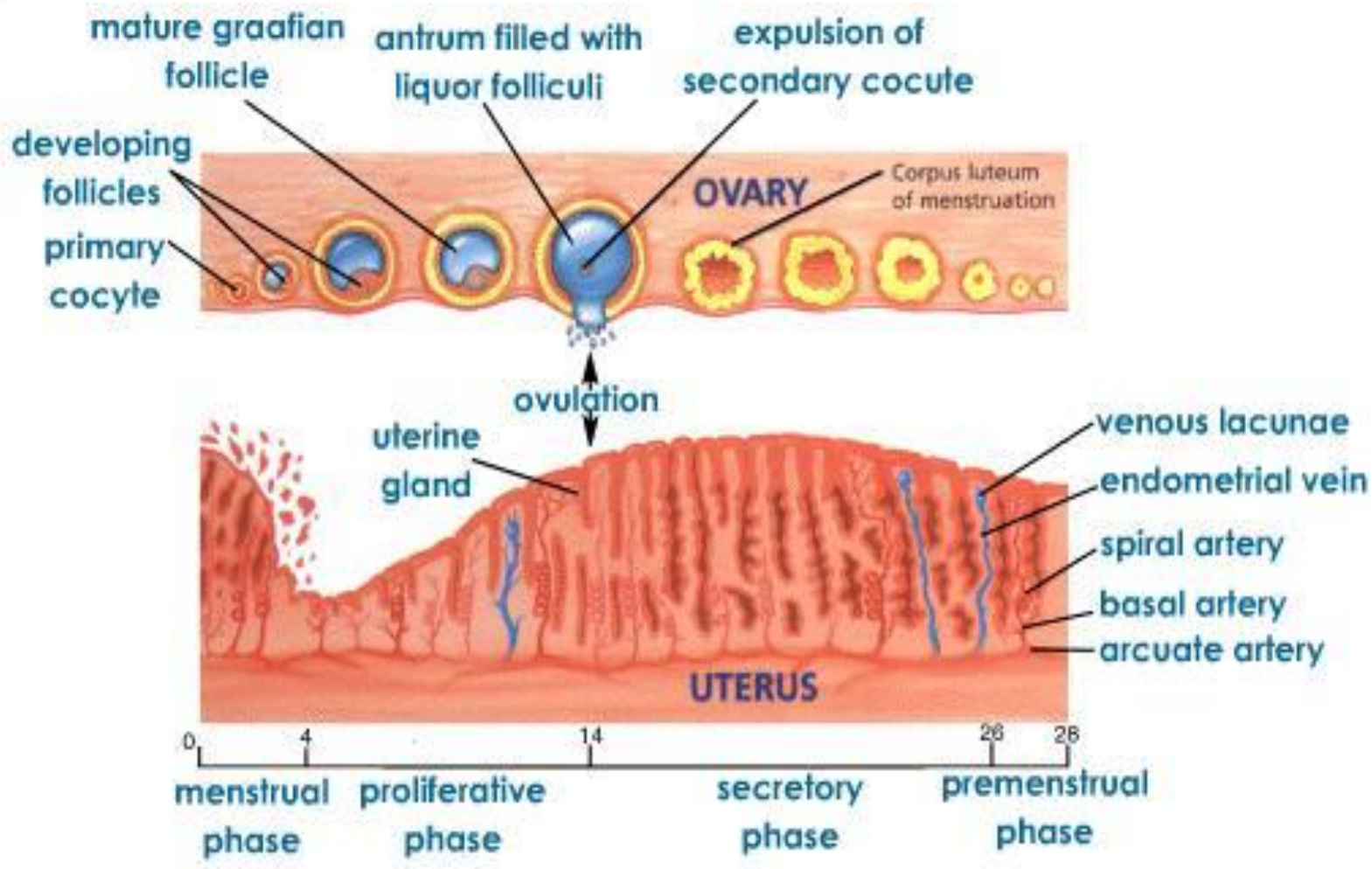
- Begins by the fertilization and ends by the beginning of the implantation.
- Major embryological events are:

1. Fertilization.
2. Cleavage.
3. Formation of morula.
4. Formation of blastocyst.

1/ Fertilization:

- - Definition:
- - Site:
- - Steps or phases:

Menstrual cycle:



Fertilization: Definition:

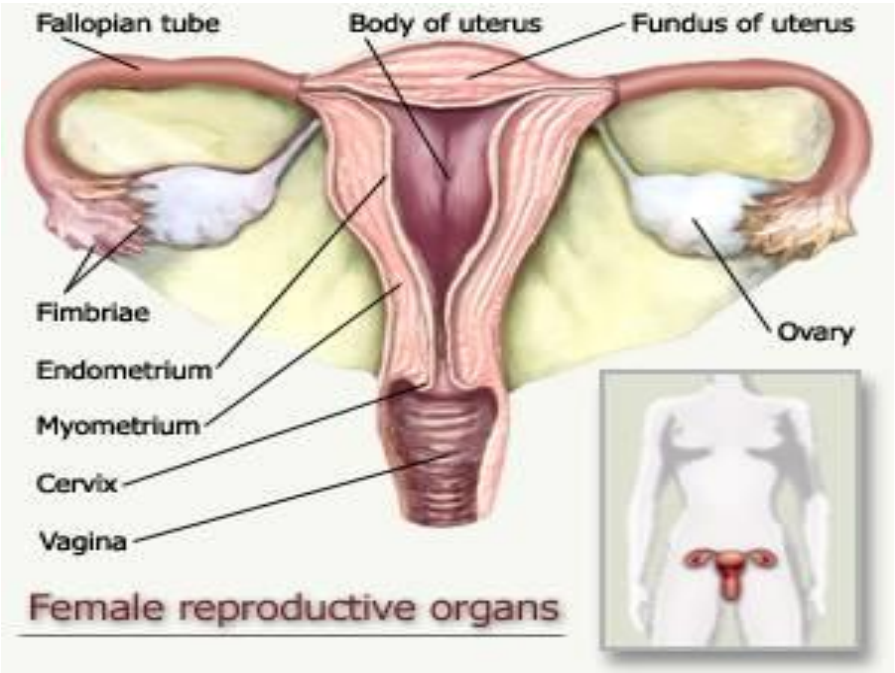
the fusion of the sperm cell nucleus with the egg cell nucleus to produce a **zygote** (fertilized egg)

Fertilization: Site:

- Ampullary part of the uterine tube.

Fertilization:

- fertilization in mammals occurs in the oviduct
- The ova is viable for approximately 24 hours after ovulation



Fertilization: Phases:

- Only 1% of sperms deposited in the vagina (200 to 300 million) enter the cervix.
- 300 to 500 reach the site of the fertilization.
- Spermatoza are not able to fertilize the oocyte unless undergo:

  - Capacitation

  - Acrosome reaction

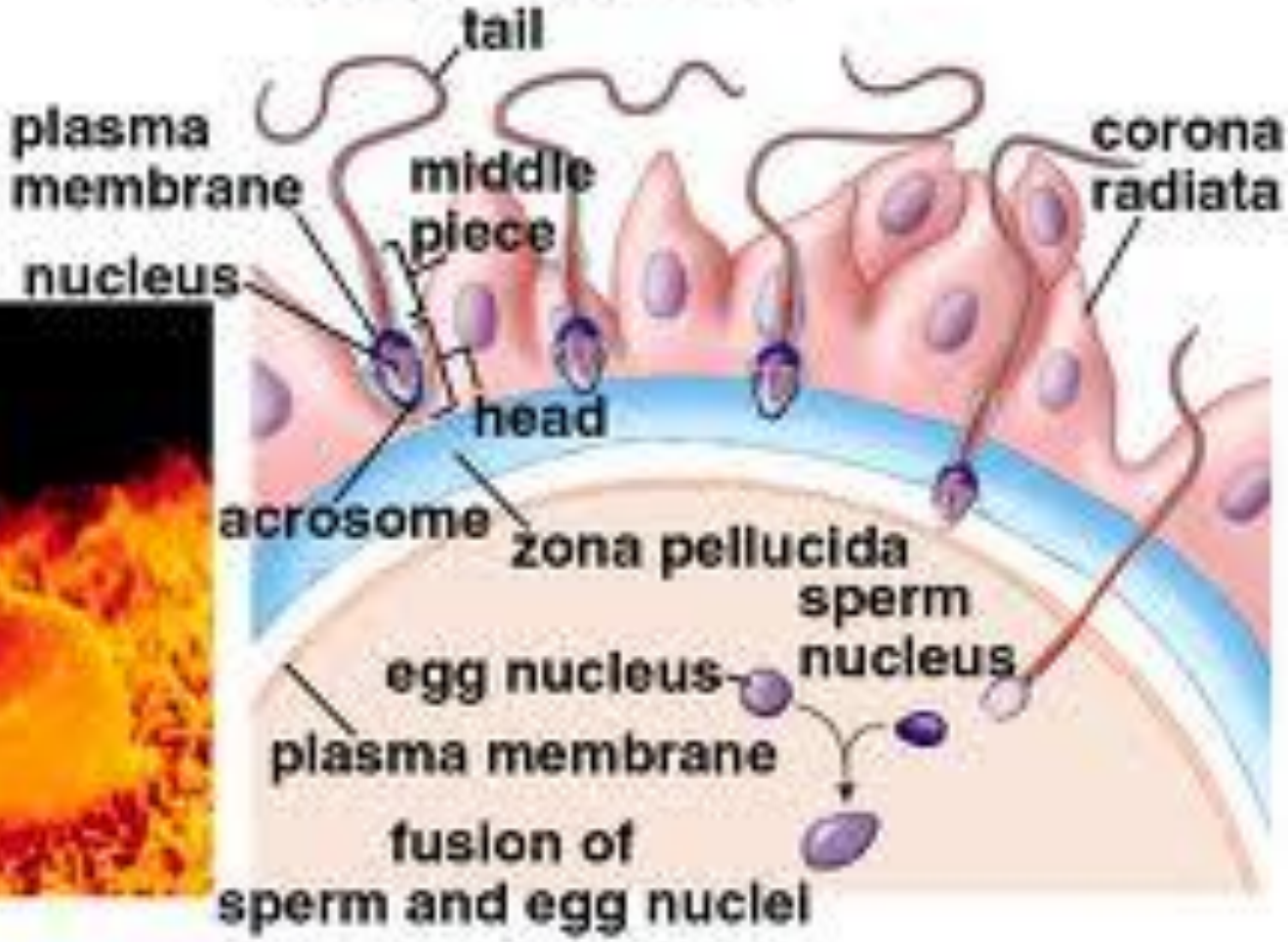
Steps or phases:

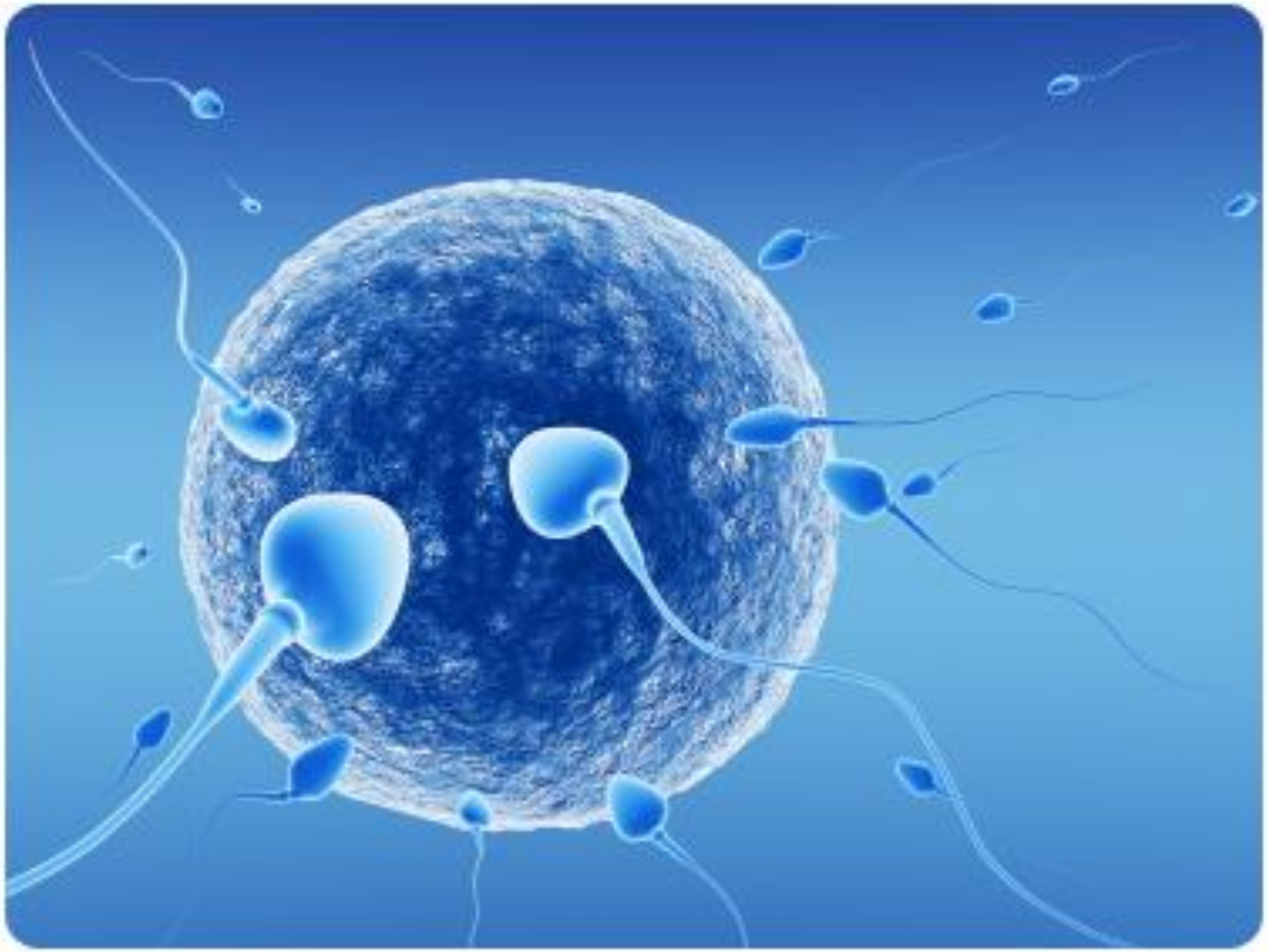
- 1- Penetration of the corona radiata.
- 2- Penetration of the zona pellucida.
  - Glycoprotein shell.
  - Facilitates & maintains sperm binding & induce acrosome reaction.
- 3- Fusion of the oocyte & sperm cell membranes.

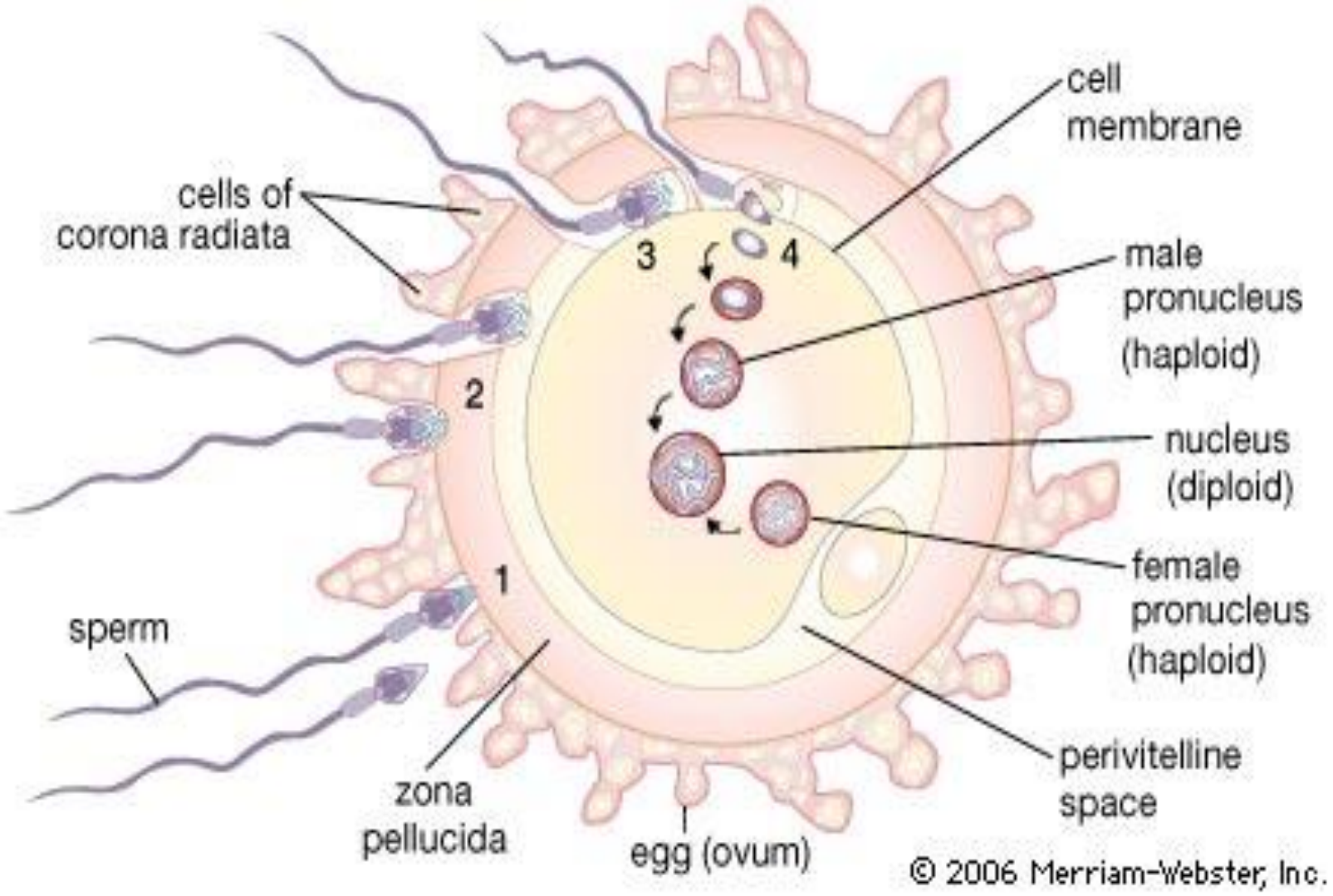
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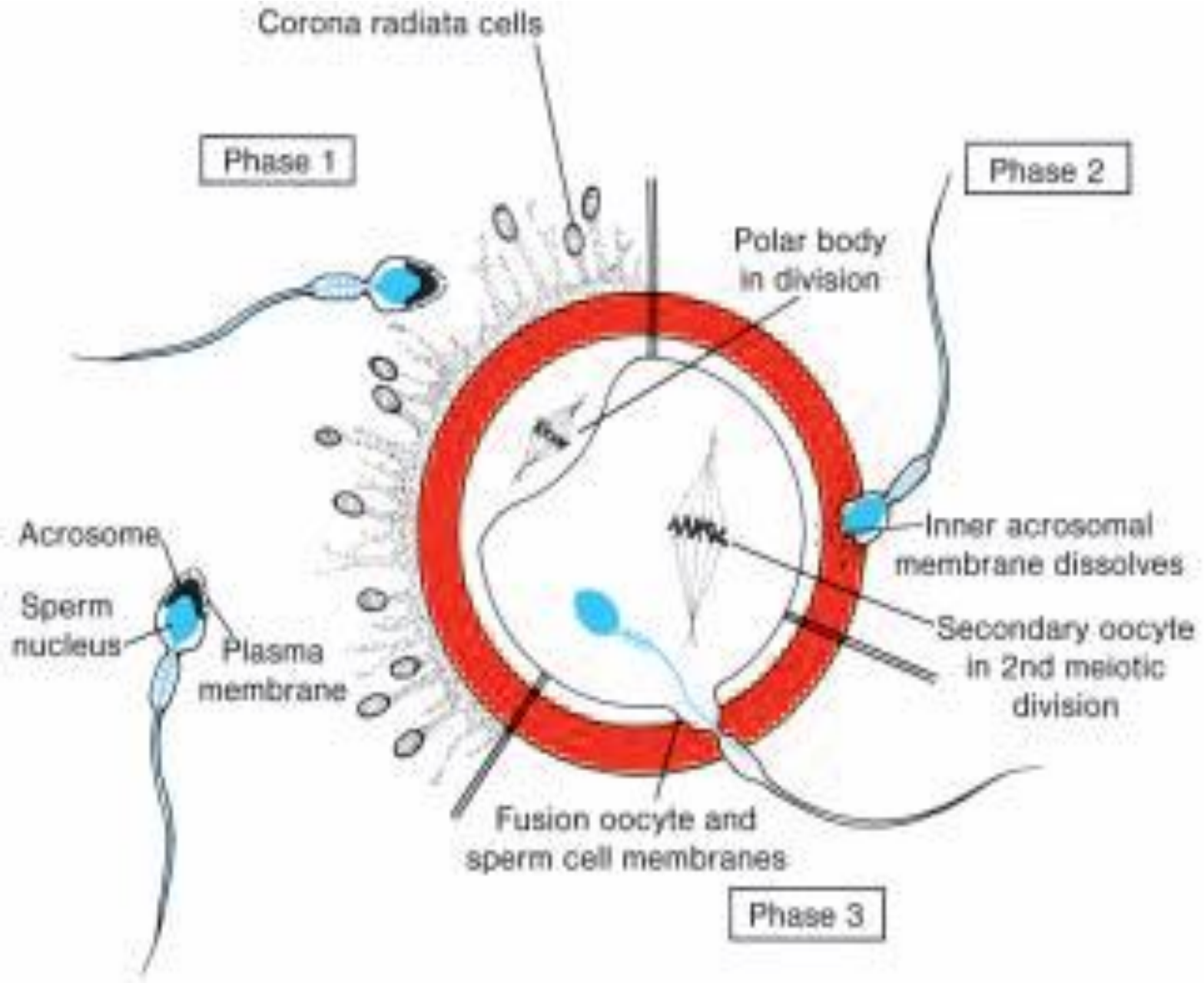
Fertilization

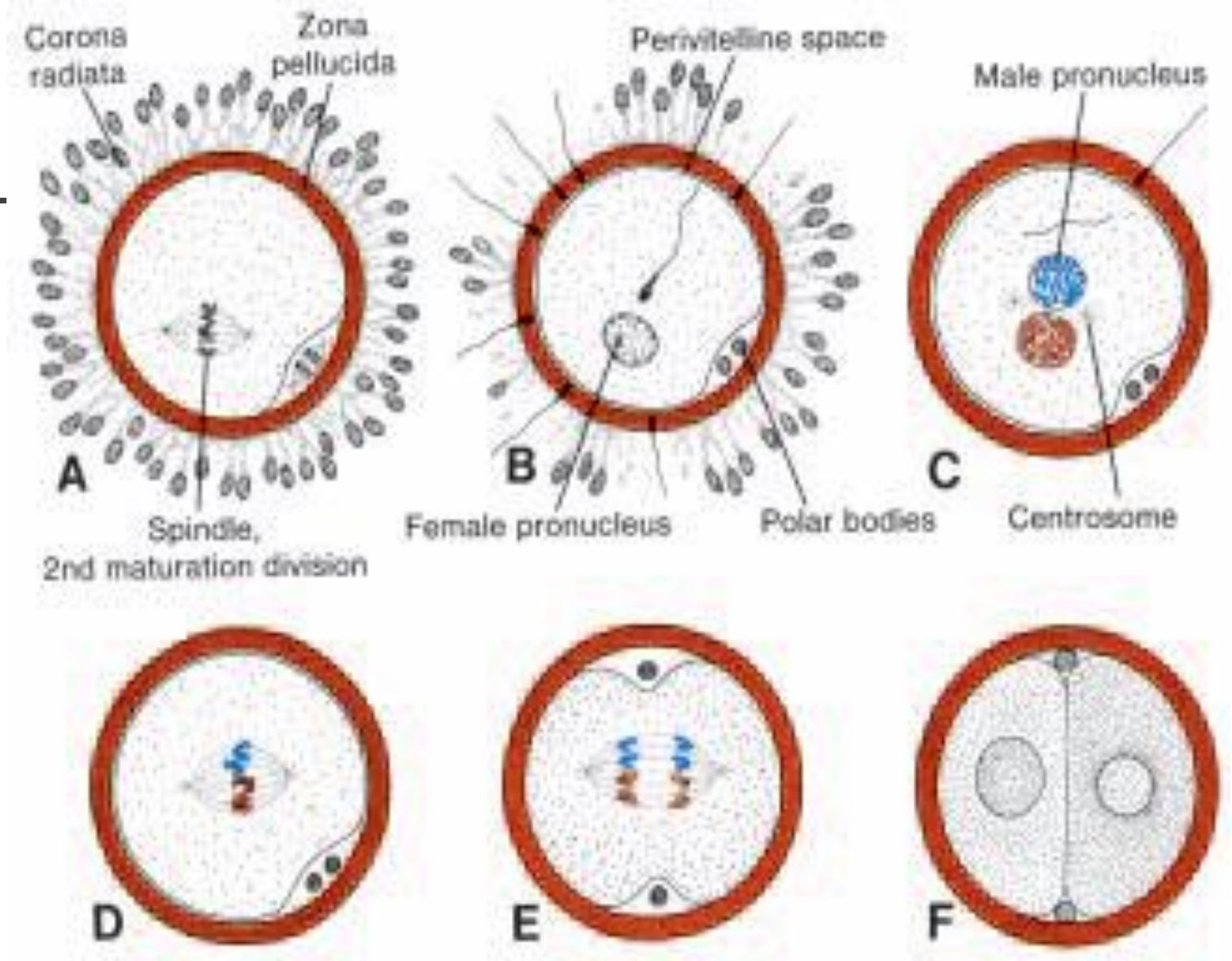


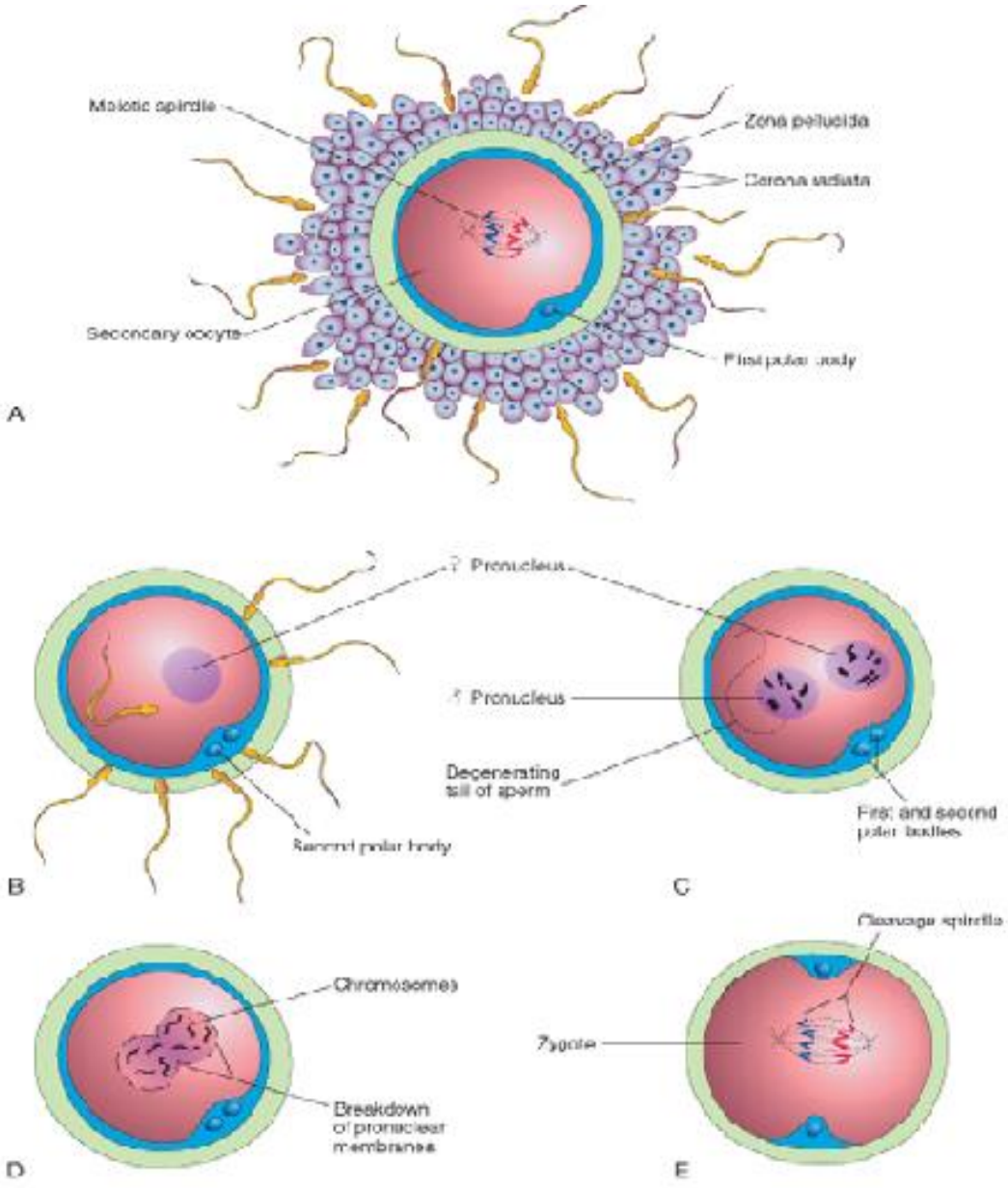





cell membrane
cells of corona radiata
male pronucleus (haploid)
nucleus (diploid)
female pronucleus (haploid)
sperm
perivitelline space
zona pellucida
egg (ovum)
1
2
3
4
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Corona radiata cells
Phase 1
Phase 2
Polar body
in division
Acrosome
Sperm
nucleus
Plasma
membrane
Inner acrosomal
membrane dissolves
Secondary oocyte
in 2nd meiotic
division
Fusion oocyte and
sperm cell membranes
Phase 3


Corona radiata
Zona pellucida
A
Spindle, 2nd maturation division
Perivitelline space
B
Female pronucleus
Polar bodies
Male pronucleus
C
Centrosome
D
E
F


Meiotic spindle
Zona pellucida
Corona radiata
Secondary oocyte
A
♀ Pronucleus
♂ Pronucleus
Degenerating tail of sperm
Second polar body
B
C
Chromosomes
Breakdown of pronuclear membranes
D
Cleavage spindle
Zygote
E

Results

- The main results of the fertilization are:

  1- Restoration of diploid number of chromosomes.

  2- Determination of the sex of embryo.

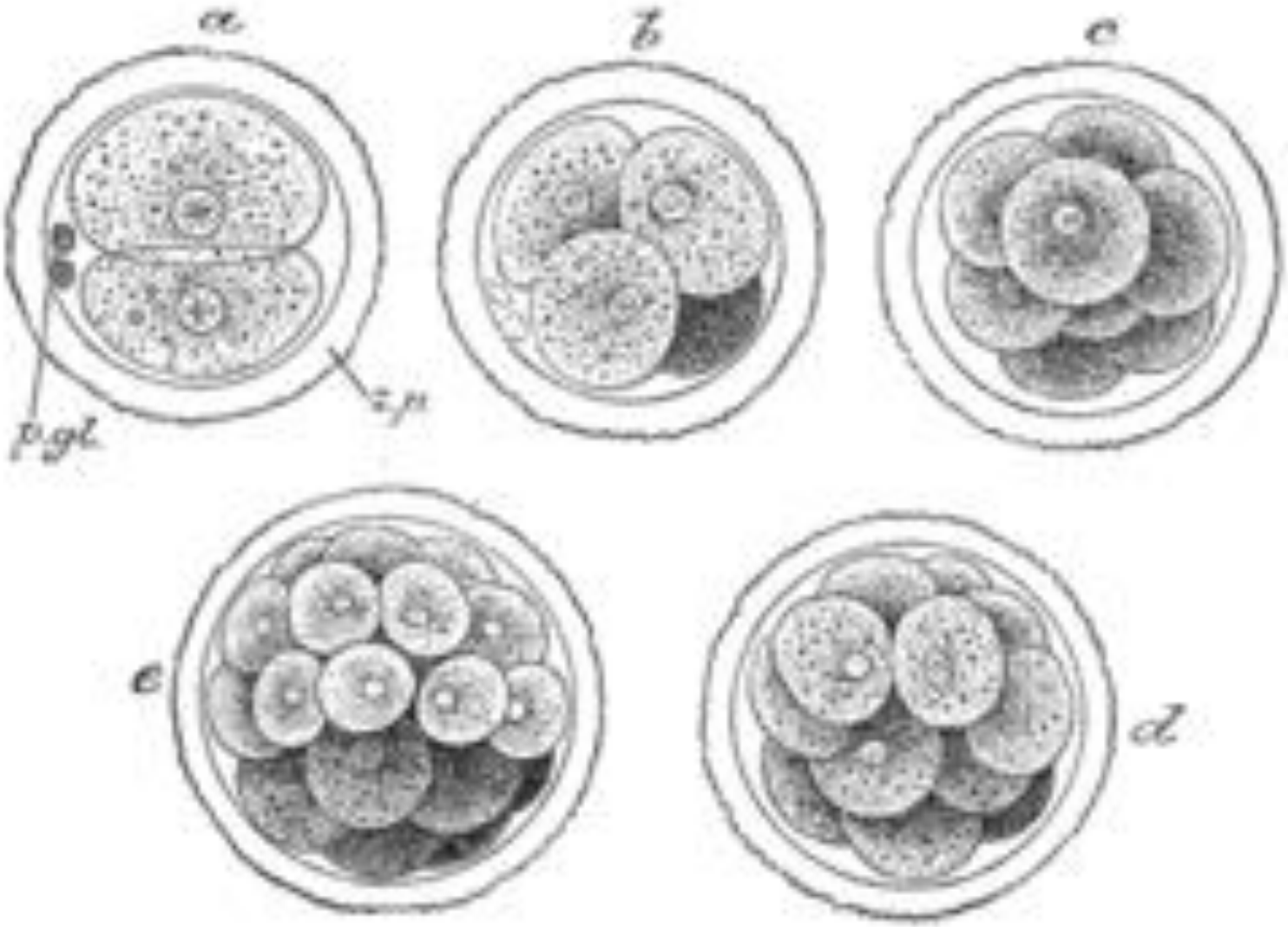
  3- Initiation of cleavage.

2/ Cleavage:

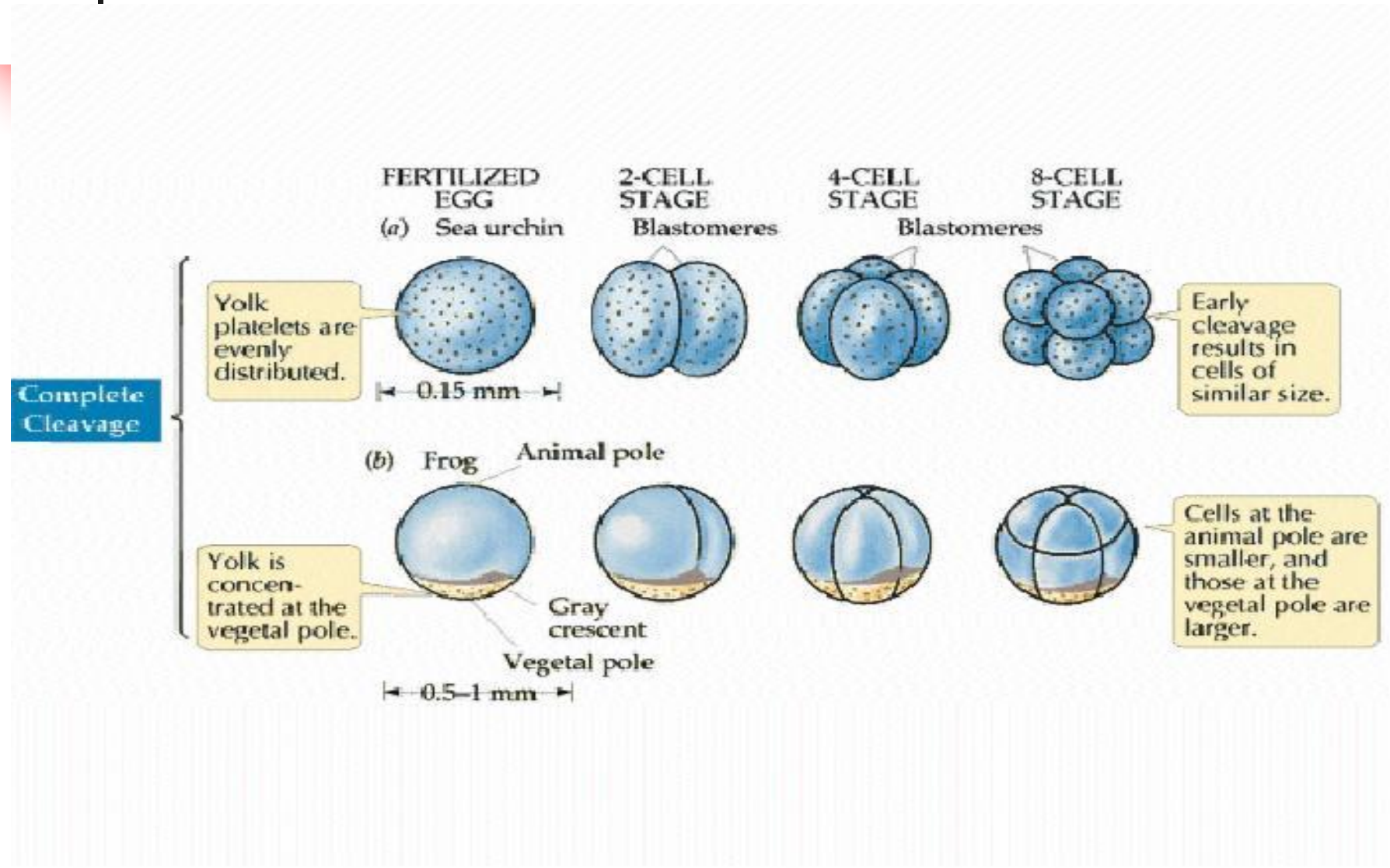
- Series of mitotic divisions .
- Blastomere.
- After the 3rd cleavage blastomeres contact with each other forming compact ball of cells (compaction)

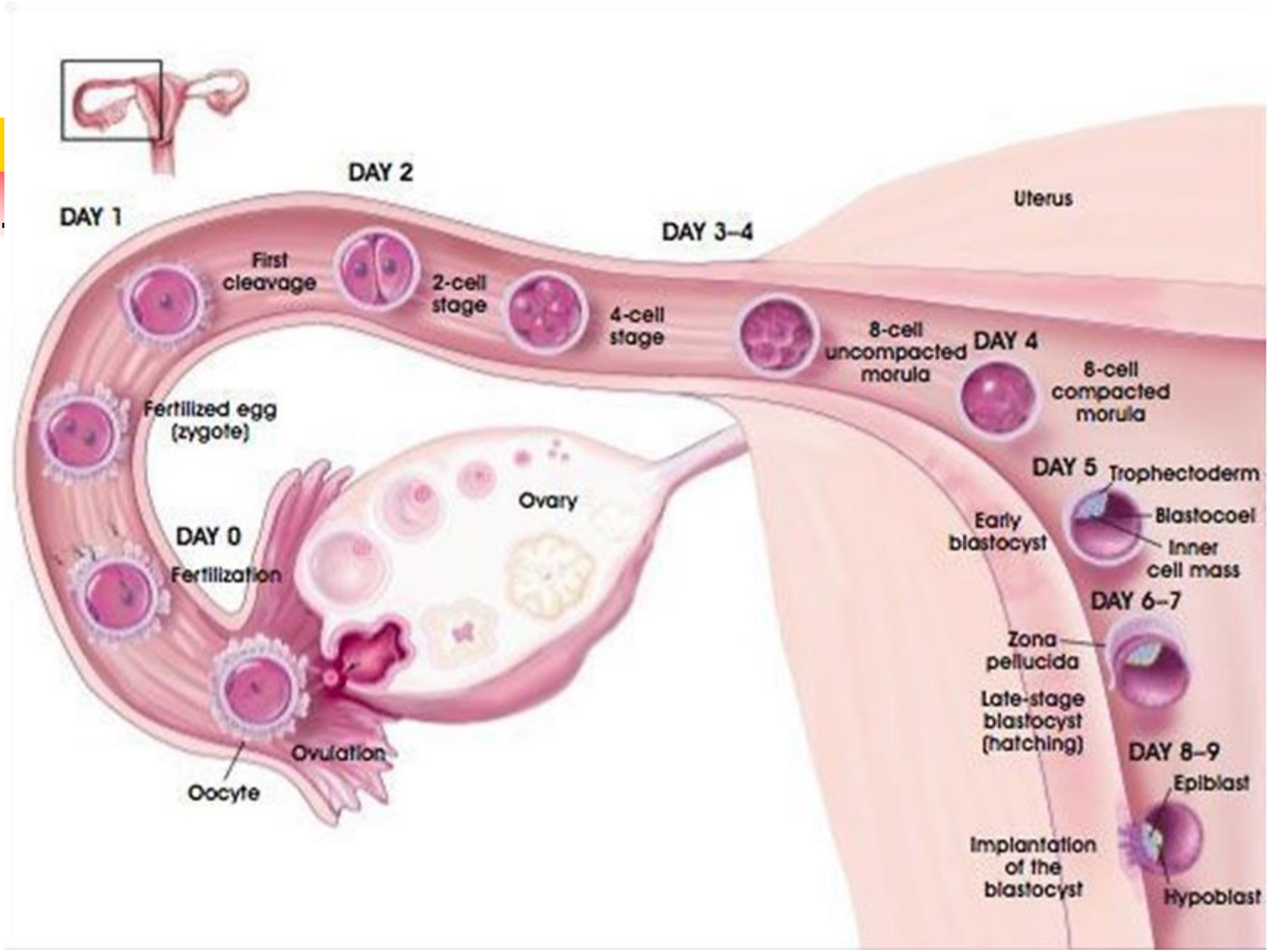
Cleavage

- the first series of cell divisions by mitosis after fertilization
- Cell division is rapid, new cells do not take time for the growth phase G_1
- **cell growth does not occur so cells decrease in size with each cleavage division**


a
b
c
p.gl.
e
d

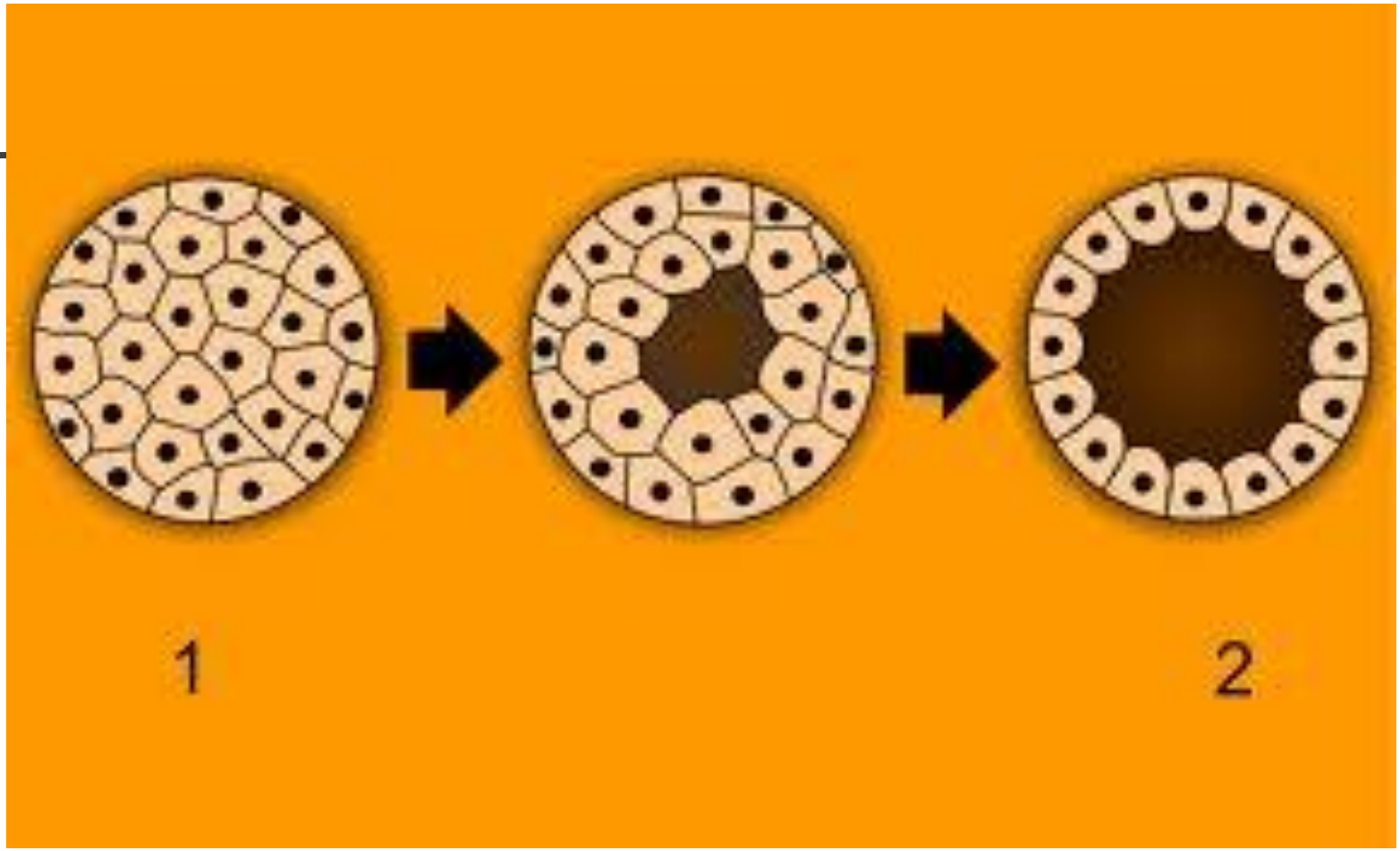
Cleavage divisions

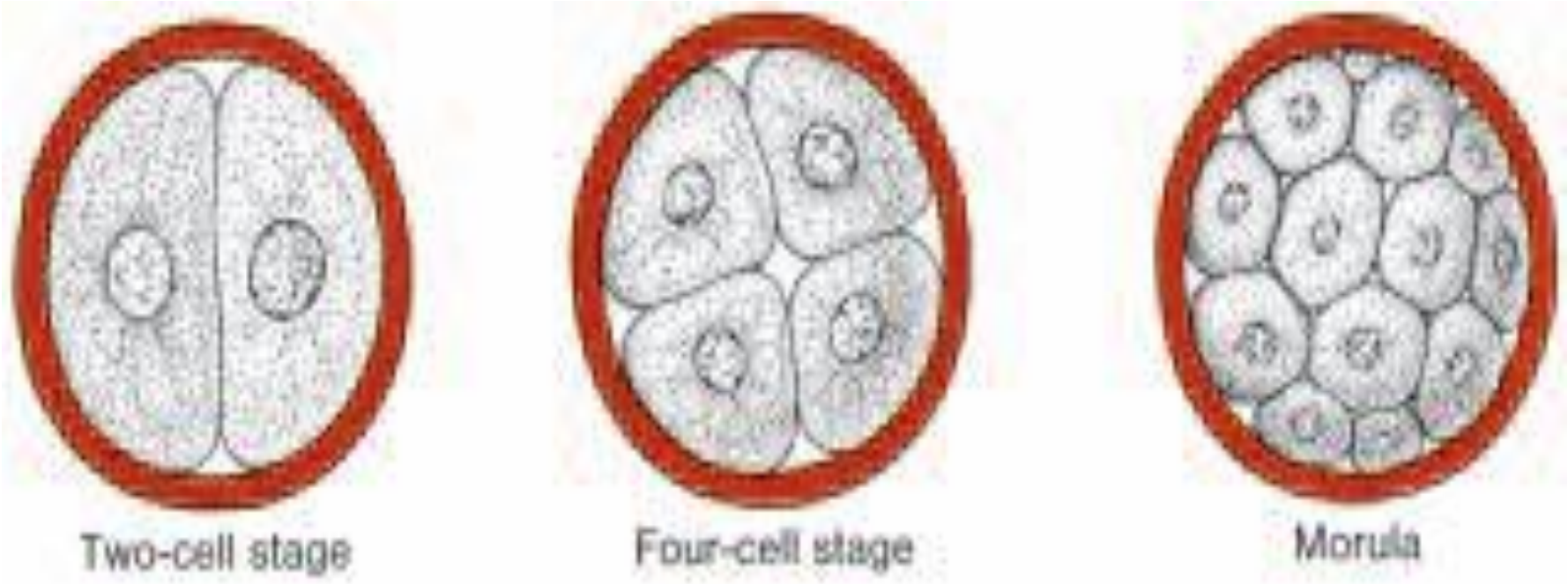


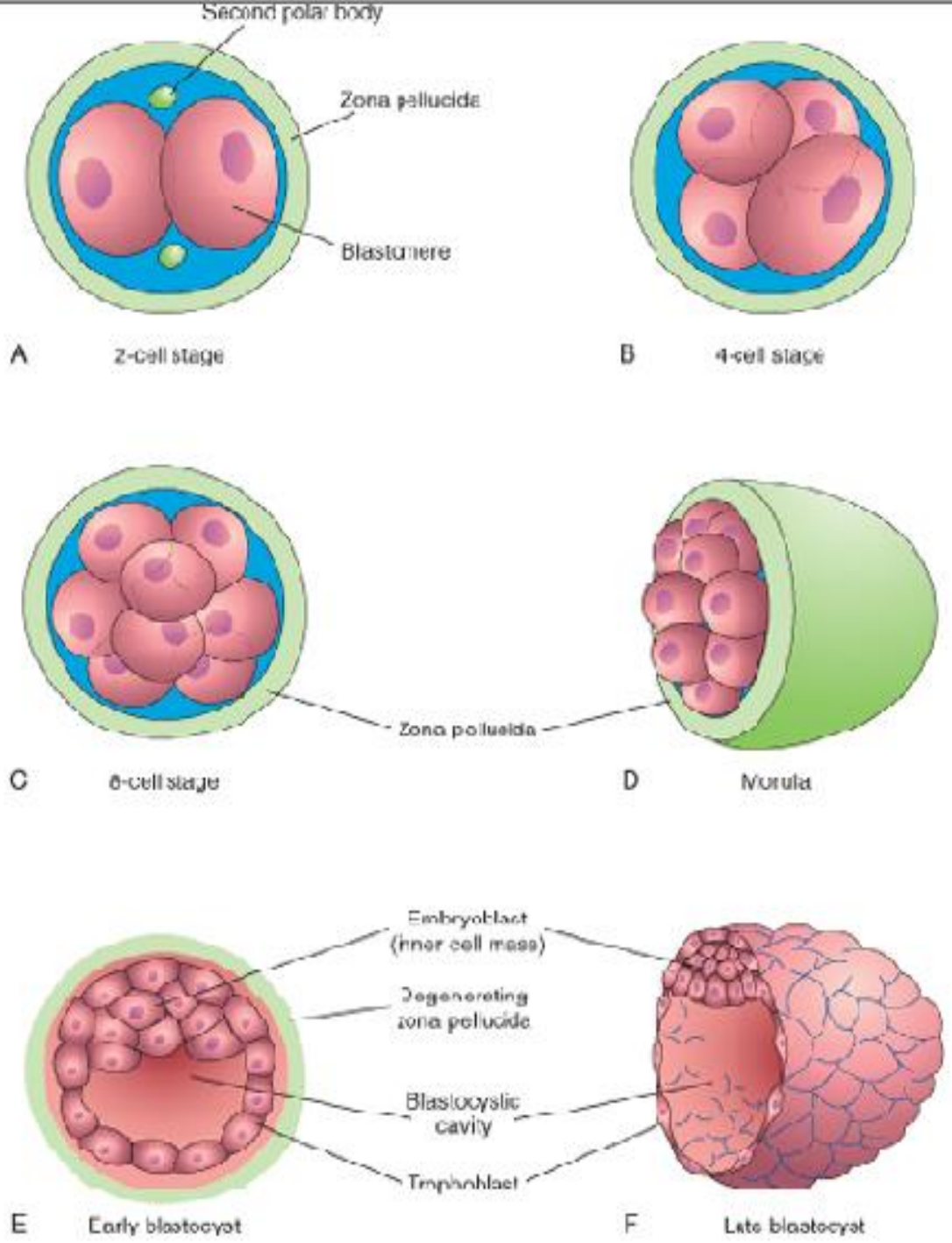

DAY 1
DAY 2
DAY 3–4
DAY 4
DAY 5
DAY 6–7
DAY 8–9
DAY 0
Uterus
First cleavage
2-cell stage
4-cell stage
8-cell uncompacted morula
8-cell compacted morula
Fertilized egg (zygote)
Ovary
Fertilization
Ovulation
Oocyte
Trophectoderm
Blastocoel
Inner cell mass
Early blastocyst
Zona pellucida
Late-stage blastocyst (hatching)
Epiblast
Hypoblast
Implantation of the blastocyst

3/ Morula:

- Formed 3 days after fertilization.
- Composed of 16 cells.
- Arranged into inner &outer cell mass.
- Inner cell mass gives rise to tissues of the embryo proper.
- Outer cell mass forms the trophoblast.

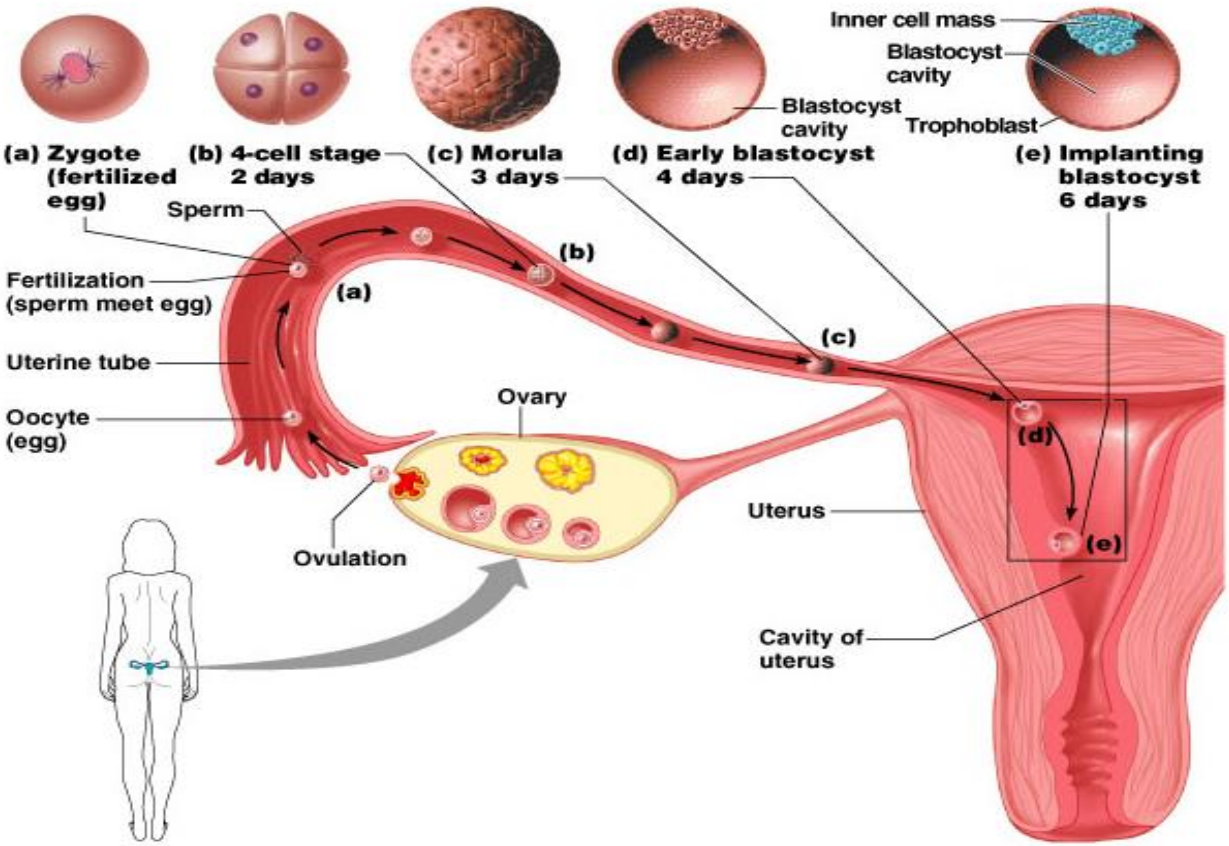

1
2

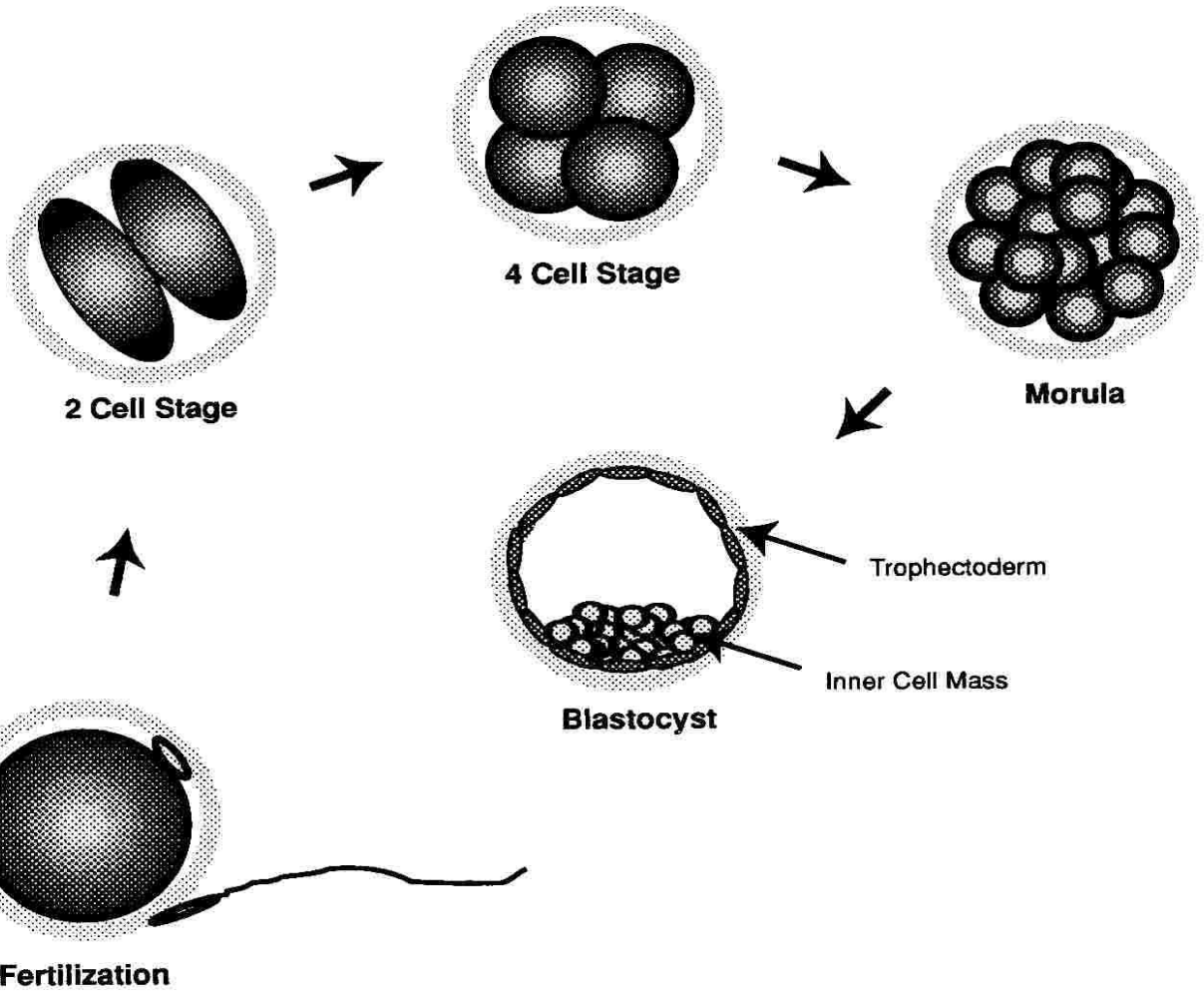

Two-cell stage
Four-cell stage
Morula


Second polar body
Zona pellucida
Blastomere
A
2-cell stage
B
4-cell stage
Zona pellucida
C
8-cell stage
D
Morula
Embryoblast
(inner cell mass)
Degenerating
zona pellucida
Blastocystic
cavity
Trophoblast
E
Early blastocyst
F
Late blastocyst

4/ Blastocyst:

- Forms when the morula enter the uterine cavity.
- Fluid penetrate zona pellucida into the intercellular spaces of inner cell mass.
- Blastocele forms.
- Inner cell mass becomes embryoblast & shift to one pole.


Inner cell mass
Blastocyst cavity
Blastocyst cavity
Trophoblast
(a) Zygote (fertilized egg)
(b) 4-cell stage 2 days
(c) Morula 3 days
(d) Early blastocyst 4 days
(e) Implanting blastocyst 6 days
Sperm
Fertilization (sperm meet egg)
Uterine tube
Oocyte (egg)
(a)
(b)
(c)
(d)
(e)
Ovary
Ovulation
Uterus
Cavity of uterus


2 Cell Stage
4 Cell Stage
Morula
Trophectoderm
Inner Cell Mass
Blastocyst
Fertilization

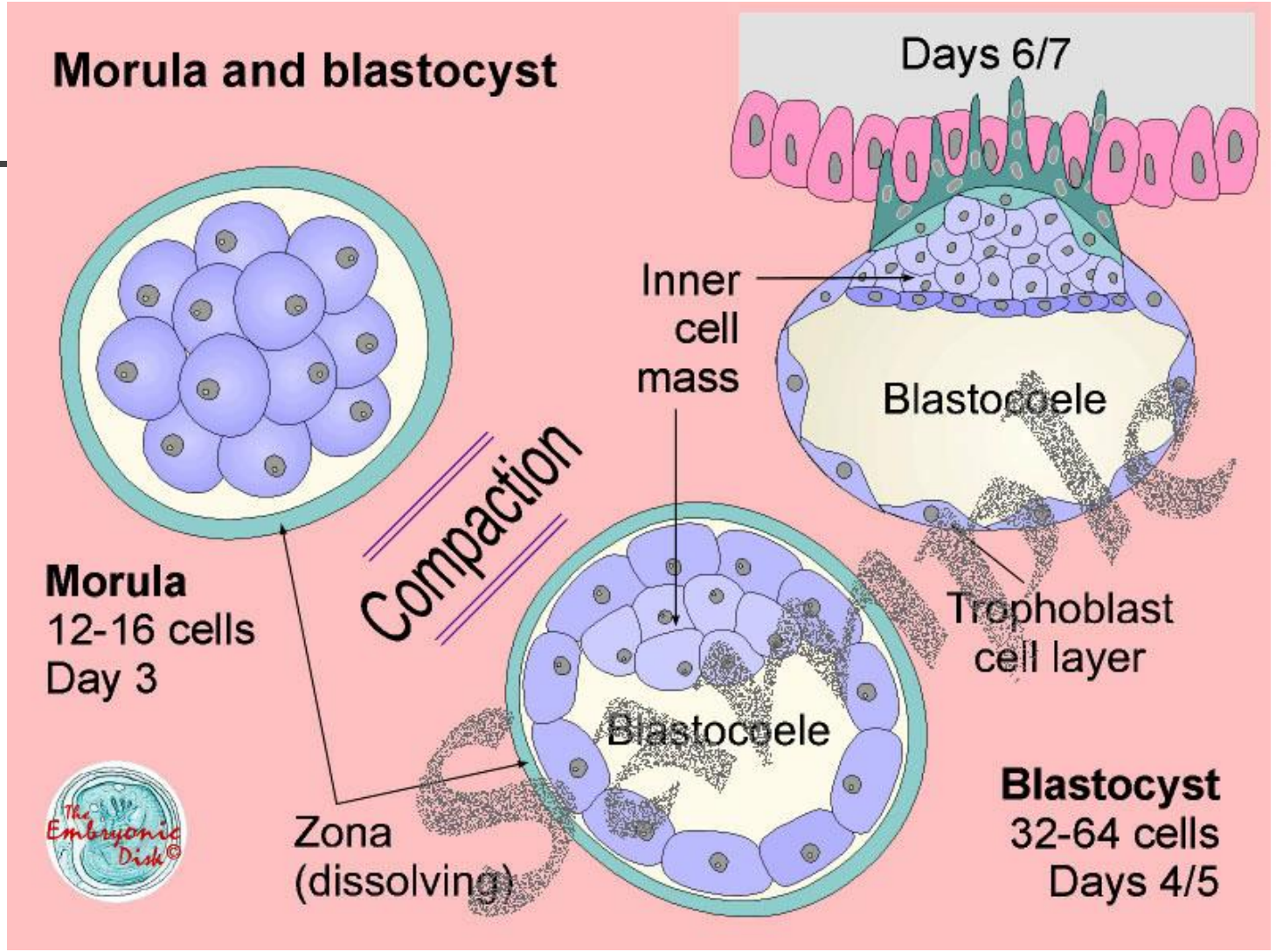
Comparison between morula & blastocyst

Morula

- 12-16 cells.
- Found in the uterine tube
- Has no cavity.
- Zona pellucida present.

Blastocyst

- More than 16 cells
- Found in the cavity.
- Has cavity.
- Zona pellucida abscent.


Morula and blastocyst
Days 6/7
Inner cell mass
Blastocoele
Compaction
Morula
12-16 cells
Day 3
Trophoblast cell layer
Blastocoele
Zona (dissolving)
Blastocyst
32-64 cells
Days 4/5
The Embryonic Disk©

Clinical correlation:

- Contraceptive methods.
  - Natural.
  - Chemicals.
  - Barriers.
  - pills.
  - intrauterine device IUD
  - Vasectomy & tubal ligation

Infertility:

- Male infertility may be:
- a result of insufficient numbers of sperm and/or poor motility.
- Normally, the ejaculate has a volume of 3 to 4 ml, with approximately 100 million sperm per ml.
- Oligozoospermia.
- Azoospermia.

- Women infertility may occur due to:

- occluded oviducts (most commonly caused by pelvic inflammatorydisease),
- hostile cervical mucus.
- immunity to spermatozoa.
- absence of ovulation.
- others.

- In vitro fertilization IVF:

-Oocytes are recovered by laparoscopy from ovarian follicles with an aspirator just before ovulation.

-The egg is placed in a simple culture medium and sperm are added.

- Fertilized eggs are monitored to the eight-cell stage and then placed in the uterus.

Teratogens

- Substances that may harm the developing fetus and result in the formation of birth defects

Teratogens include:

- Alcohol, certain drugs/medications, infections, and certain chemicals

Fetal Alcohol Syndrome

Can result in mental retardation / learning disability

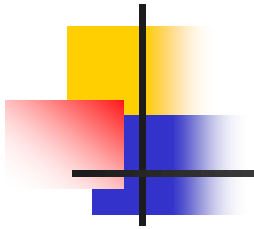
Facial Features

- Epicanthal folds
- Small, widely spaced eyes
- Flat midface
- Short, upturned nose
- Smooth, wide philtrum
- Thin upper lip
- Underdeveloped jaw



Cleft Lip / Palate

- maternal alcohol consumption and maternal smoking during the early stages of pregnancy have been shown to increase the risk of developing orofacial clefts



Thank you